

WHAT IS CLAIMED IS:

- 1                    1.     An apparatus for forming a material on a semiconductor wafer, the  
2 apparatus comprising:  
3                    a processing chamber defined by walls;  
4                    a wafer support positioned within the processing chamber and configured to  
5 receive a semiconductor wafer;  
6                    a processing gas supply; and  
7                    ✓ a gas distribution showerhead overlying and separated from the wafer support,  
8 the gas distribution showerhead comprising a face plate having an inlet portion comprising a  
9 hole in fluid communication with an elongated slot of an outlet portion of the face plate.
- 1                    2.     The apparatus of claim 1 wherein a length of the elongated slot is at  
2 least one-half a thickness of the face plate.
- 1                    3.     The apparatus of claim 1 wherein the gas distribution showerhead  
2 further comprises a blocker plate including a perforation, the blocker plate positioned  
3 upstream of, and in fluid communication with, the inlet portion of the face plate.
- 1                    4.     The apparatus of claim 1 wherein the elongated slots are continuous  
2 and oriented concentrically.
- 1                    5.     The apparatus of claim 1 wherein a cross-sectional width of the  
2 elongated slot is larger than a cross-sectional width of the hole.
- 1                    6.     The apparatus of claim 5 wherein the cross-sectional width of the  
2 elongated slot is at least 2.25x larger than the cross-sectional width of the hole.
- 1                    7.     A gas distribution face plate comprising:  
2 a face plate body having a thickness;  
3 an inlet portion configured to receive a flow of a processing gas, the inlet  
4 portion comprising an aperture having a width;  
5 an outlet portion configured to convey the processing gas flow to a  
6 semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication  
7 with the aperture.

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1 8. The gas distribution face plate of claim 7, wherein the elongated slot  
2 has a length at least one-half the thickness of the face plate body.

1 9. The gas distribution face plate of claim 7 wherein the elongated slot is  
2 circular and continuous.

1 10. The gas distribution face plate of claim 7 wherein a width of the  
2 elongated slot is greater than the width of the aperture.

1 11. The gas distribution face plate of claim 10 wherein the width of the  
2 elongated slot is at least 2.25x larger than the width of the aperture.

1 12. An apparatus for forming a material on a semiconductor wafer, the  
2 apparatus comprising:  
3 a processing chamber defined by walls;  
4 a wafer support positioned within the processing chamber and configured to  
5 receive a semiconductor wafer;  
6 a processing gas supply; and  
7 a gas distribution showerhead overlying the wafer support and including a  
8 tapered face plate proximate to the wafer support, an edge of the tapered face plate exhibiting  
9 a reduced thickness relative to a thickness of a center of the face plate to create a taper angle,  
10 such that material deposited on a wafer in contact with the wafer support exhibits a uniform  
11 center-to-edge thickness.

1 13. The apparatus of claim 12 wherein the taper angle is between about  
2 0.5° and 5°.

1 14. The apparatus of claim 12 wherein the tapered face plate comprises:  
2 an inlet portion configured to receive a flow of a processing gas, the inlet  
3 portion comprising an aperture having a width;  
4 an outlet portion configured to convey the processing gas flow to a  
5 semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication  
6 with the aperture.

1 15. The apparatus of claim 14, wherein the elongated slot has a length at  
2 least one-half a thickness of the face plate.



1 16. The apparatus of claim 14 wherein the elongated slot is circular and  
2 continuous.

5 17. The apparatus of claim 14 wherein a width of the elongated slot is  
2 greater than the width of the aperture.

1 18. The apparatus of claim 17 wherein the width of the elongated slot is at  
2 least 2.25x larger than the width of the aperture.

1 19. A method of distributing gas during a semiconductor fabrication  
2 process comprising:  
3 flowing a gas from a gas source to an inlet portion of a gas distribution face  
4 plate featuring a hole having a width; and  
5 flowing the gas from the hole to a surface of a semiconductor wafer through  
6 an elongated slot of an outlet portion of a gas distribution face plate.

1 20. The method of claim 19 wherein the gas is flowed through an  
2 elongated slot having a length at least one-half a thickness of the gas distribution face plate.

1 21. The method of claim 19 wherein at least one of a carrier gas and a  
2 process gas are flowed through the face plate.

1 22. The method of claim 19 wherein the gas is flowed during a chemical  
2 vapor deposition (CVD) process.

1 23. The method of claim 19 wherein the gas is flowed during a process of  
2 high temperature deposition of undoped silicate glass, such that a spacing between the face  
3 plate and the wafer is 300 mils or less.

1 24. The method of claim 19 wherein the flowed gas is selected from at  
2 least one of the group consisting of tetraethylorthosilane (TEOS), triethylphosphate (TEPO),  
3 triethylborate (TEB), ozone (O<sub>3</sub>), oxygen, helium, and nitrogen (N<sub>2</sub>).

1 25. The method of claim 19 wherein the flowed gas results in deposition of  
2 a material selected from the group consisting of borosilicate glass (BSG), phosphosilicate  
3 glass (PSG), and borophosphosilicate glass (BPSG).



1                   26.     The method of claim 19 wherein the gas is flowed from the gas  
2     distribution faceplate having an edge portion recessed relative to a center portion to create a  
3     face plate taper angle of between about 0.5° and 5°.

1                   27.     The method of claim 19 wherein the gas is flowed during a dry etching  
2     process.

1                   28.     An apparatus for forming a material on a semiconductor wafer, the  
2     apparatus comprising:

3                   a processing chamber defined by walls;

4                   a wafer support positioned within the processing chamber and configured to  
5     receive a semiconductor wafer;

6                   a processing gas supply; and

7                   a gas distribution showerhead overlying the wafer support and including a  
8     tapered face plate proximate to the wafer support, the tapered face plate comprising,

9                   an inlet portion configured to receive a flow of a processing  
10     gas, the inlet portion comprising an aperture having a width, and

11                   an outlet portion configured to convey the processing gas flow  
12     to a semiconductor wafer, the outlet portion comprising an elongated slot in  
13     fluid communication with the aperture,

14                   wherein an edge of the tapered face plate exhibits a reduced thickness relative  
15     to a thickness of a center of the face plate to create a taper angle, such that material deposited  
16     on a wafer in contact with the wafer support exhibits a uniform center-to-edge thickness.

1                   29.     The apparatus of claim 28 wherein the taper angle is between about  
2     0.5° and 5°.